and bones in a fossil state, creates a considerable degree of surprise; and by connecting the present animals with those that are extinct, adds a link to that chain of gradation which is the most interesting to the comparative anatomist and to the geologist.

An Account of Experiments for determining the Length of the Pendulum vibrating Seconds in the Latitude of London. By Capt. Henry Kater, *F.R.S.* Read January 29, 1818. [*Phil. Trans.* 1818, *p.* 33.]

It has long been a desideratum in science, to determine the precise length of a pendulum vibrating seconds in a given latitude. Most of those who have undertaken this inquiry have endeavoured to find the centre of oscillation; but as this depends upon the regular figure and uniform density of the body employed, it involves difficulties which may be considered as insurmountable. Despairing, therefore, of success in any attempt founded upon such principle, Captain Kater endeavoured to discover some other property of the pendulum less liable to objections; and was so fortunate as to perceive one which promised an unexceptionable result.

It is known that the centres of suspension and oscillation are reciprocal; or, in other words, if a body be suspended by its centre of oscillation, its former point of suspension then becomes the centre of oscillation, and the vibrations in both positions will be performed in equal times. Now as the distance of the centre of oscillation from the point of suspension depends upon the figure of the body employed, if the arrangement of its particles be changed, the place of the centre of oscillation will also suffer a change. Suppose, then, a body to be furnished with a point of suspension, and another point on which it may vibrate, to be fixed as nearly as can be estimated in the centre of oscillation, and in a line with the point of suspension and centre of gravity; if the vibrations in each position should not be equal in equal times, they may readily be made so, by shifting a moveable weight, with which the body is to be furnished, in a line between the centres of suspension and oscillation; when the distance between the two points about which the vibrations were performed, the length of a simple pendulum, and the time of its vibrations, will at once be known, uninfluenced by any irregularity of density or of figure. The mode of suspension which the author adopted was the knife-edge, of which the various advantages and disadvantages are pointed out, and the modes of overcoming the latter described.

The pendulum consisted of a thin bar of plate-brass, pierced with two triangular holes at the distance of 39·4 inches from each other, to admit the knife-edges, which were made of wootz, and finished to an angle of 120°, and firmly screwed to brass knee-pieces. The pendulum is prolonged at either extremity by a slip of deal, extending about twenty-two inches beyond the knife-edges. Three weights are employed for the adjustments. The great weight is immoveably fixed beyond the knife-edges; the second weight slides on the bar,

near the knife-edge, at the opposite end, and may be fixed at pleasure; the third weight is a small slider, intended to move near the centre of the bar, upon which are engraved divisions of one twentieth of an inch, seen through an opening in the slider. The support of the pendulum consisted of agate planes bedded in bell-metal.

In proceeding to the details of the experiments, the author acknowledges his obligations to Henry Browne, Esq. F.R.S., who permitted him to use his house in Portland-place, and his excellent clocks, for the purposes of the investigation. The greatest daily variation of the clock used as a standard of comparison did not exceed three tenths of a second between the months of February and July.

By the method of coincidences which Captain Kater employed, the number of vibrations made by the pendulum in twenty-four hours might be obtained in the space of eight minutes to within half a second of the truth; and the usual correction was applied for the extent of the arc of vibration.

The pendulum being suspended with the great weight above, the number of vibrations in twenty-four hours was determined; and if it differed when the pendulum was inverted, it was equalized by moving the second weight, and finally adjusted by the slider, every allowance being made for the temperature, and the height of the barometer being noted. Thus the number of vibrations in twenty-four hours, of a pendulum equal in length to the distance between the knife-edges at a given temperature and barometrical height, was ascertained.

The next sections of Captain Kater's communication refer to the apparatus and methods employed for the measurement of the distance between the knife-edges; for the comparison of the British standard measures of the highest authority; and to the expansion of the pendulum, which was found to be ·00000996 of its length for each degree of Fahrenheit's thermometer.

After describing the methods of deducing the length of the pendulum vibrating seconds, and the corrections for the buoyancy of the atmosphere, the author makes it appear, that the distance of the knife-edges, at the temperature of 62° Fahr., by the mean of three several sets of measurements, the greatest difference between any two of which did not amount to $\frac{1}{10,000}$th of an inch, was, upon Sir George Shuckburgh's scale, 39·44085 inches. From a table inserted in this paper of twelve sets of experiments, each set consisting of four, from which, and from the preceding measurements, the length of the seconds' pendulum *in vacuo* is calculated, it appears that seven of these sets are within $\frac{1}{10,000}$th of an inch of the mean result; two a little exceeding $\frac{1}{10,000}$th of an inch; and of the remaining three, the greatest difference is less than $\frac{3}{10,000}$th of an inch; so that the mean result must, it is presumed, be very near the truth.

To the length thus found, the author next applies a correction for the height of the place of observation above the level of the sea. The advantages of his different methods are then explained; and the conclusion of the whole is, that the length of the pendulum vibrating

seconds *in vacuo*, at the level of the sea, measured at the temperature of 62° Fahr., and the latitude of the place of observation, deduced from the data contained in the trigonometrical survey, being 51° 31′ 8″·4 N., is,

	Inches.
By Sir George Shuckburgh's Standard....	39·13860
By General Roy's Scale.....	39·13717
By Bird's Parliamentary Standard.....	39·13843

On the Length of the French Mètre estimated in parts of the English Standard. By Capt. Henry Kater, *F.R.S.* Read February 5, 1818. [*Phil. Trans.* 1818, *p.* 103.]

One of the objects of the Committee of the Royal Society appointed for the purpose of determining the length of the seconds' pendulum having been to compare the French Metre with the British Standard Measure, two metres were procured from Paris for that purpose; one called the *Mètre à Bouts*, being a bar of platinum, of which the terminating planes are supposed to be parallel, and the distance between them the length of the metre; the other termed the *Mètre à Traits*, consisting also of a bar of platinum, but upon which the length of the metre is shown by two very fine lines.

The latter was first examined, by placing it in contact with Sir George Shuckburgh's standard scale; their surfaces being in the same plane, and care being taken that their temperatures were alike. The same micrometer microscopes employed in the pendulum experiments were used, and were brought alternately over the metre and over the scale. It appeared from the mean result, properly corrected, of fourteen comparisons, the greatest difference between any one of which and the mean result is less than $\frac{2}{10,000}$ths of an inch, that the length of the *Mètre à Traits*, in inches of Sir George Shuckburgh's scale, is 39·37076 inches. The author next describes the means resorted to for ascertaining the length of the *Mètre à Bouts;* which appears, from the results of four sets of experiments, each set consisting of five, the greatest difference between any one of which and the mean result is $\frac{1}{10,000}$th of an inch, to be 39·37081 inches of Sir George Shuckburgh's standard.

After explaining the principles upon which the column in the tables intitled "Correction for Temperature" is constructed, Captain Kater remarks, that we may consider the mean derived from both metres, viz. 39·37079 inches of Sir George Shuckburgh's scale, or 39·37062 inches of Bird's parliamentary standard, as the length of the French metre.